

Toxic Substance Reduction for Medical Laboratories

Reduce toxic substances with improvements in laboratory practices and chemical substitution



Laboratory Practices

Track chemical use by each department¹

The first step in reducing the use of a toxic substance is understanding how and where it is being used. Implement a tracking system to determine all uses of each chemical and identify high volume users. Use this information to prioritize pollution prevention in areas where changes will have the least impact on operations and the greatest potential reduction in toxic substance use.

Develop a list of authorized or preferred chemicals²

Ensure that all chemicals purchased have a purpose in the lab and will be managed and disposed of properly. Identify any toxic substances and provide alternatives where possible. Encourage employees to order less-toxic or non-toxic alternatives as long as they are suitable for the process. Consult resources such as the Environmental Protection Agency (EPA) Safer Chemical Ingredients List or the

American Chemical Society (ACS) Green Chemistry Institute for alternatives to commonly used solvents or analytical techniques.^{3 4}

Minimize the amount of chemicals used per sample^{2 5}

When toxic substances are a necessary part of sample processing, use microscale analytical techniques or implement automated systems if they are not already in place. These can significantly reduce the amount of reagent required per sample processed as well as increase the number of samples processed at a time, reduce labor requirements and reduce waste generation.

Other best practices

- Provide multiple sizes of containers of fixatives and instruct employees to use the smallest volume possible for each sample.
- Stain slides by applying only as much as necessary instead of dipping into a bath.

- Minimize sample sizes when possible to reduce the need for other reagents accordingly.

Chemical Substitution

Investigate formaldehyde-free fixatives as alternatives to formalin^{6 7}

Alternative fixatives may be alcohol-based, zinc-based, or glyoxal-based in place of formaldehyde. There are commercially available options or some can be prepared in the laboratory. Morphology resulting from alternative fixatives may be different than that expected of formalin fixation, but they have still been found to be suitable for routine use in several studies. Consult published studies for more detailed information or carry out tests to determine the effectiveness of alternative fixatives in specific applications.

Use xylene substitutes for clearing and deparaffinizing slides^{7 8 9}

Clearing agents including mineral oils, alkane-based, and terpene-based



materials have all been studied as possible substitutes for xylene in tissue processing. Processing times or staining results may vary compared to xylene clearing, but in many cases the substitutes have been found to be equally or more effective. Although these substitutes are not always effective for deparaffinization, heated solutions of 1.7 percent household dish washing soap can be used for this step.

Eliminate the use of mercury-containing reagents wherever possible^{2 5}

Zenker's solution and B5 fixatives both contain mercury and should be used as little as possible. Zinc-based fixatives may be adequate substitutes. Sodium azide can be used in place of thimerosal buffer solutions. The calorimetric method for analyzing chloride samples can be replaced with ion-selective electrode analysis, which does not require the use of mercury reagents.

See Hazardous Waste Reduction for Medical Laboratories¹⁰ for more information.

References

- ¹ [Ohio EPA Division of Environmental and Financial Assistance. Laboratory Pollution Prevention.](#)
- ² [Healthcare Environmental Resource Center. Laboratory Chemicals.](#)
- ³ [EPA. Safer Choice.](#)
- ⁴ [ACS. ACS Green Chemistry Institute.](#)
- ⁵ [Toronto ChemTRAC. Greening Medical Laboratories.](#)
- ⁶ [Zanini C, Gerbaudo E, Ercole E, Vendramin A, Forni M. Evaluation of two commercial and three home-made fixatives for the substitution of formalin: a formaldehyde-free laboratory is possible.](#)
- ⁷ [Aydin I, Yörükoglu K, Cingöz S, Aqilkaya S. The effect of alternative solutions to formaldehyde and xylene on tissue processing.](#)
- ⁸ [Buesa RJ, Peshkov MV. Histology without xylene.](#)
- ⁹ [Negi A, Puri A, Gupta R, Chauhan I, Nangia R, Sachdeva A. Biosafe alternative to xylene: A comparative study.](#)
- ¹⁰ [ADEQ. Hazardous Waste Reduction for Medical Laboratories.](#)

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